

# Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase I

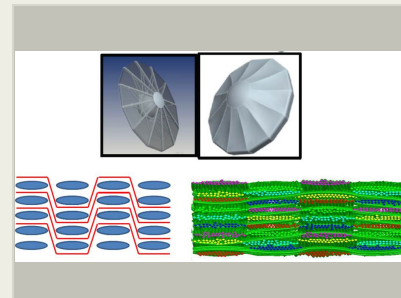
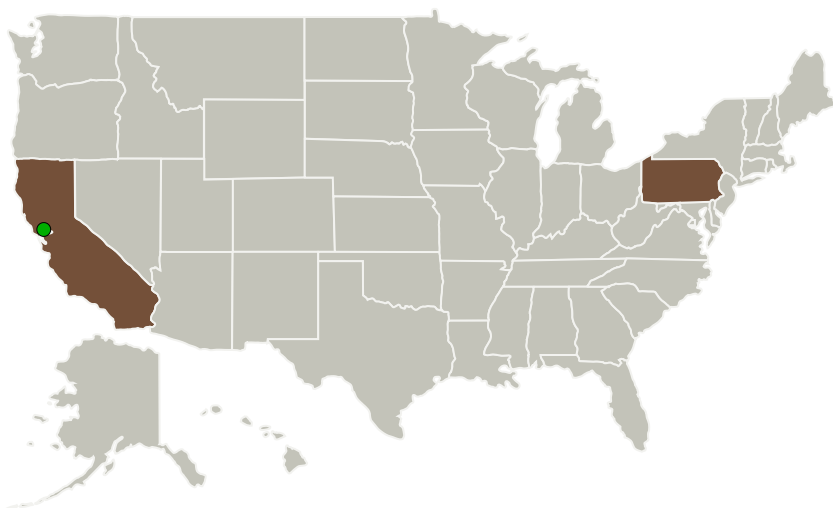
Completed Technology Project (2013 - 2013)



## Project Introduction

Current NASA programs, such as Adaptable, Deployable Entry and Placement Technology (ADEPT) and Woven Thermal Protection Systems (WTPS) are looking to fill a gap in ablative TPS for future missions to Venus and Saturn, human missions beyond Lunar, and Mars Sample Return Missions. Both of these programs rely on the use of 3D woven carbon fiber preforms. Therefore, there is a need to be able to predict the properties and performance of a woven material. Validation of predictive modeling tools would allow for the use of these tools to design and optimize the 3D weaves, significantly reducing the cost of fabrication and testing of a variety of configurations. While there are proven tools for the prediction of laminate composite properties, textile composites are relatively new materials and much less effort has been focused on modeling this class of materials. Materials Research & Design (MR&D) has experience in working with and designing 3D woven preforms for use in composite material reinforcement and has developed a suite of analytical tools to define the detailed geometry of 3D woven preforms for use in calculating material properties. However, these tools currently do not have the capability to predict material strengths. Within the proposed Phase I effort, MR&D will enhance the existing tool by incorporating the ability to calculate material strengths of 3D weaves. Strength predictions will be made for two different 3D woven hybrid preform reinforced phenolic panels and compared to measured test data for validation.

## Primary U.S. Work Locations and Key Partners



Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites

## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

# Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase I

Completed Technology Project (2013 - 2013)



Organizations Performing Work	Role	Type	Location
Materials Research and Design, Inc.	Lead Organization	Industry	Wayne, Pennsylvania
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Pennsylvania

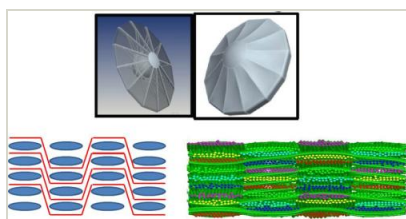
## Project Transitions

**May 2013:** Project Start**November 2013:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140413>)

## Images



### Project Image

Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites  
(<https://techport.nasa.gov/image/136656>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Materials Research and Design, Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

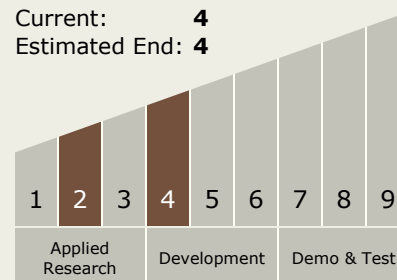
Carlos Torrez

### Principal Investigator:

Kerry D Hopp

## Technology Maturity (TRL)

Start: 2  
Current: 4  
Estimated End: 4



# Calculation of Effective Material Strengths for 3D Woven Hybrid Preforms and Composites, Phase I

Completed Technology Project (2013 - 2013)



## Technology Areas

### Primary:

- TX09 Entry, Descent, and Landing
  - └ TX09.4 Vehicle Systems
    - └ TX09.4.5 Modeling and Simulation for EDL

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System